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Spectrophotometric analysis of heavy metals in coastal waters of West Bengal

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Abstract : Concentrations of dissolved Zn, Cu and Pb were analysed in the water sampled from the south-western tip of Sagar Island which is at the confluence of the Bay of Bengal and the Hooghly river (21°00' N to 21°53' N latitude and 88°02' E to 88°15' E meridians). The area is contaminated with the wastes generated from various industries located along the Hooghly estuary particularly in the lower stretch. The concentrations of heavy metals in the ambient aquatic phase exhibited a sharp seasonal oscillation with the highest value during monsoon and lowest during premonsoon. The concentrations of dissolved heavy metals seem to be controlled by the ambient aquatic salinity and pH.

Keywords : Heavy metals, spectrophotometric analysis, surface water pH

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Metals are important component in marine and estuarine environment. River runoff, mechanical weathering of rocks, atmospheric fall-out are the natural important sources of metal in coastal water. The natural concentrations of metals in sea water are very low and therefore, the possibilities of contaminations are high [1]. Infact, all industrial processes involving water are potential sources of metallic contamination in coastal waters.

Zinc finds its way in the coastal water bodies from industrial wastes, metal plating and plumbing units. The element is essential in many metallozymes, but becomes toxic to biota at higher levels.

The important sources of copper in coastal water bodies are electroplating units, industrial and domestic wastes, algicides often used in the adjacent shrimp culture farms etc. Although copper is not very toxic to fauna at low concentrations, the metal has an adverse effect on phytoplankton and floral community.

Pb is highly toxic in nature and finds its way in coastal waters through the discharge of industrial waste waters, such as from printing, dyeing, oil refineries *etc*. The Pb from the ambient media may enter the human system through consumption of contaminated marine products like edible fin fishes, prawns, oysters, seaweeds *etc*.

Apart from the industrial sources, Zn, Cu and Pb are contributed in coastal water bodies through antifouling paints used to prevent the growth of marine organisms at the bottom of the fishing vessels, trawlers, ships *etc* [2].

Based on this background, an attempt has been made in this paper, to monitor the monthly variations of dissolved Zn, Cu and Pb in the southwestern sector of Sagar Island.

The entire network comprised the monthly sampling of surface water from the south western sector of Sagar Island (lighthouse area) during the period January, 1999 to December 1999 for estimating the concentrations of dissolved Zn, Cu and Pb during the high tide condition. Physico-chemical variables like surface water temperature, pH and salinity were also analysed simultaneously to determine their effect on the process of speciation of heavy metals in the ambient media. Surface water salinity was analysed by argentometric method, pH of the same water was detected by a portable pH meter (sensitivity = ± 0.02) and surface water temperature was recorded with a celsius thermometer. In order to analyse dissolved heavy metals of the sample water, monthly water

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samples were collected using 10 litre Teflon-lined Go-Flo bottles, fitted with teflon taps and deployed on a rosette or on Kevlar line with additional surface sampling carried out manually The collected samples were filtered through Nucleopore filters. Aliquots of the filtrates were acidified with sub-boiling distilled nitric acid to a pH of about 2 and stored in cleaned Tarson bottles Dissolved heavy metals were separated and pre-concentrated from the samples using dithiocarbamate complexation and subsequent extraction into Freon TF, followed by back extraction into nitric acid [3,4] Finally, the extracts were analyzed for Zn, Cu and Pb with the atomic absorption spectrophotometer (Perkin-Elmer Type 3030)

Dissolved heavy metals in the surface waters of the sampling station increased during the monsoon season, the period characterized by low salinity and low pH of the ambient aquatic phase (Table 1 and Figure 1). The main cause behind the high concentration of dissolved heavy metals in monsoon may be attributed to the increased

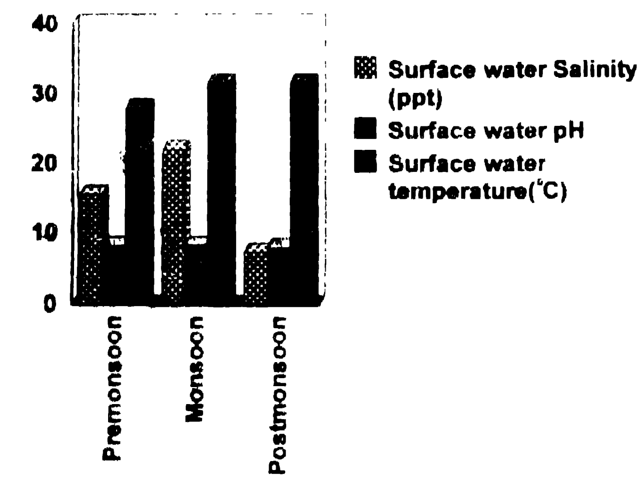

Figure 1a. Seasonal variation of physico-chemical variables in the aquatic phase around Sagar Island

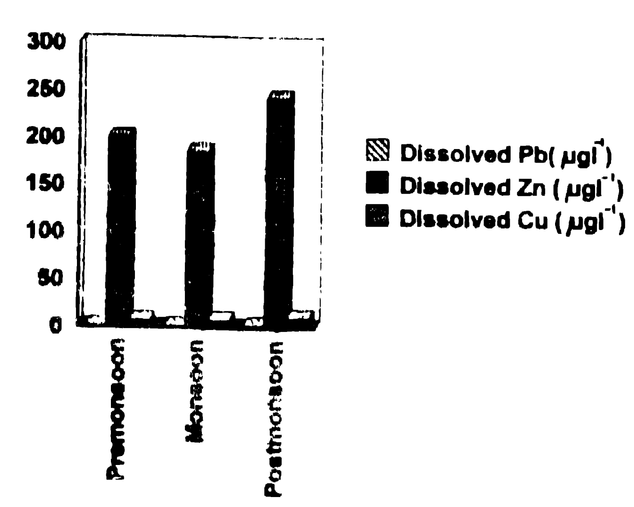

Figure 1b. Seasonal variation of dissolved heavy metals in the aquatic phase around Sagar Island

Table 1. Mean monthly variations of physico-chemical variables in the aquatic phase around Sagar Island during January, 1999 to December 1999

	Surface water salinity (ppt)	Surface water pH	Surface water tempera-ture (°C)	Dissolved Pb (μgl^{-1})	Dissolved Zn (μgl^{-1})	Dissolved
January 1999	16 92	8 20	26 50	2 44	201 22	
February	17 05	8 25	27 20	2 40	232 72	
March	19 31	8 29	29 30	2 31	203 11	
April	21 65	8 30	31 60	2 18	187 26	
May	23 00	8 31	32 00	1 97	185 08	
June	23 92	8 32	32 80	1 46	169 03	
July	9 69	8 05	31 70	2 63	230 06	
August	7 85	8 02	30 80	2 75	241 12	
September	6 30	8 00	32 00	2 94	290 02	
October	5 49	8 00	31 30	2 88	205 40	
November	13 28	8 14	30 00	1 28	186 35	
December 1999	14 74	8 18	27 80	2 40	183 27	

run-off from the adjacent landmasses during the season. [illegible] run-off from the highly urbanised and industrialized [illegible] Calcutta and the Haldia port-cum-industrial complex is [illegible] charged with wide spectrum of heavy metals which pla[illegible] significant role for the high value of heavy metal concentr[illegible] in the coastal water bodies [5]. Another important determin[illegible] factor for the increment of dissolved heavy meta[illegible] concentrations in the coastal water bodies during monso[illegible] may be related to lowering of aquatic pH and salinity tha[illegible] favours the process of dissolution from the sediment bed t[illegible] aquatic phase [6]. This is confirmed through significa[illegible] negative correlation values of dissolved heavy metals w[illegible] ambient aquatic pH and salinity [Table 2]

Table 2. Inter-relationship between selected physico-chemical variab[illegible] in the aquatic phase of the southwestern Sagar Island

Combination	'r' value	'p' val[illegible]
Surface water salinity × Surface water temperature	–0 05084	NS
Surface water salinity × Dissolved Pb	-0 66772	<0 [illegible]
Surface water salinity × Dissolved Zn	–0 84002	0 [illegible]
Surface water salinity × Dissolved Cu	-0 77424	0 [illegible]
Surface water pH × Surface water salinity	0 98713	0 [illegible]
Surface water pH × Surface water temperature	-0 14289	NS
Surface water pH × Dissolved Pb	–0 63234	<0 0[illegible]
Surface water pH × Dissolved Zn	–0 80557	<0 0[illegible]

Table 2. *(Cont'd)*

Combination	'*r*' value	'*p*' value
Surface water pH × Dissolved Cu	–0 81581	<0 01
Surface water temperature × Dissolved Pb	–0 10494	IS
Surface water temperature × Dissolved Zn	0 13857	IS
Surface water temperature × Dissolved Cu	0 42227	IS

'IS' means 'insignificant'

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